The documentation and process conversion measures necessary to comply with this revision shall be completed by 5 February 2004.

INCH-POUND

MIL-PRF-19500/370E
5 November 2003
SUPERSEDING
MIL-PRF-19500/370D
05 August 1999

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, HIGH-POWER, TYPE 2N3442, JAN, JANTX, AND JANTXV

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for NPN silicon, high-power transistor. Three levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (similar to TO-3), (see 3.4).

* 1.3 Maximum ratings.

P_T (1) $T_A = +25°C$	P_T (2) $T_C = +25°C$	V_{CBO}	V_{CEO}	V_{EBO}	V_{CER}	I_B	I_C	T_J and T_{STG}
W	W	V dc	V dc	V dc	V dc	A dc	A dc	°C
6.0	117	160	140	7	150	7	10	-65 to +200

(1) Derate linearly 34.2 mW/°C above $T_A = +25°C$.
(2) See figure 2 for temperature-power derating curves.

* 1.4 Primary electrical characteristics.

	h_{FE1} (1)	$V_{CE(sat)}$ (1)	h_{fe}	$R_{\theta JC}$ (2)
	$V_{CE} = 4$ V dc $I_C = 3$ A dc	$I_C = 3$ A dc $I_B = 300$ mA dc	$V_{CE} = 4$ V dc $I_C = 3$ A dc, f = 100 kHz	
		V dc		°C/W
Min	20		1.0	
Max	70	1.0		1.5

(1) Pulsed (see 4.5.1).
(2) See figure 3, transient thermal impedance graph.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

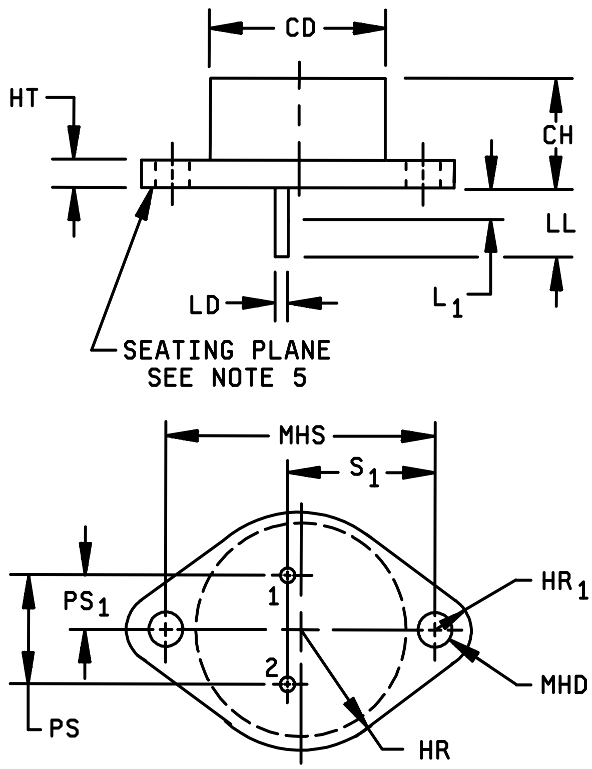


FIGURE 1. Physical dimensions (similar to TO-3).

Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD		.875		22.22	
CH	.270	.350	6.86	8.89	
HR	.495	.525	12.57	13.34	
HR_1	.131	.188	3.33	4.78	
HT	.060	.135	1.52	3.43	
LD	.038	.043	0.97	1.09	
LL	.312	.500	7.92	12.70	
L_1		.050		1.27	
MHD	.151	.165	3.84	4.19	
MHS	1.177	1.197	29.90	30.40	
PS	.420	.440	10.67	11.18	4,5
PS_1	.205	.225	5.21	5.72	4,5
S_1	.655	.675	16.64	17.15	

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Lead 1 is emitter; lead 2 is base; and case is collector.
4. Measured at points .050 inch (1.27 mm) - .055 inch (1.4 mm) below the seating plane. When gauge is not used, measurement will be made at the seating plane.
5. The seating plane of the header shall be flat within .001 inch (0.03 mm) concave to .004 inch (0.10 mm) convex inside a .930 inch (23.62 mm) diameter circle on the center of the header and flat within .001 inch (0.03 mm) concave to .006 inch (0.15 mm) convex overall.
6. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

* FIGURE 1. Physical dimensions (similar to TO-3) - Continued.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

STANDARD

DEPARTMENT OF DEFENSE

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

* 3.1 General. The individual item requirements shall be as specified in MIL-PRF-19500 and as modified herein.

* 3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).

* 3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500.

* 3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and figure 1.

* 3.4.1 Lead finish. Lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

* 3.5 Marking. Marking shall be in accordance with MIL-PRF-19500.

* 3.6 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4, and table I.

* 3.7 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table I herein.

* 3.8 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

* 4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).

b. Screening (see 4.3).

c. Conformance inspection (see 4.4 and tables I, II, and III).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500.

* 4.2.1 Group E qualification. Group E inspection shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the associated specification that did not request the performance of table III tests, the tests specified in table III herein shall be performed by the first inspection lot of this revision to maintain qualification.

* 4.3 Screening (JANTX and JANTXV levels). Screening shall be in accordance with table IV of MIL-PRF-19500, and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table IV of MIL-PRF-19500)	Measurement JANTX, JANTXV levels only
(1) 3c	Thermal impedance (transient), see 4.3.2.
11	h_{FE1}, I_{CEX}
12	See 4.3.1
13	Subgroup 2 of table I herein. ΔI_{CEX} = 100 percent or 500 μA dc whichever is greater; Δh_{FE1} = 25 percent of initial value.

(1) Thermal impedance limits ($Z_{\theta JC}$) shall not exceed the thermal impedance curve on figure 3.

* 4.3.1 Power burn-in conditions. Power burn-in conditions are as follows: T_J = +187.5°C ±12.5°C; V_{CB} = 10 - 30 V dc; $T_A \leq$ +35°C.

* 4.3.2 Thermal impedance ($Z_{\theta JX}$ measurements). The $Z_{\theta JX}$ measurements shall be performed in accordance with method 3131 of MIL-STD-750 using the guidelines in that method for determining I_M, I_H, t_H, t_{MD} (and V_C where appropriate). The $Z_{\theta JX}$ limit used in screen 3c shall comply with the thermal impedance graph in figure 3 (less than or equal to the curve value at the same t_H time) and/or shall be less than the process determined statistical maximum limit as outlined in method 3131.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500.

* 4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500, and table I herein. Electrical measurements (end-points) shall be in accordance with the applicable inspections of table I, subgroup 2 herein.

* 4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 and paragraph 4.4.2.1 herein. Electrical measurements (end-points) shall be in accordance with the applicable inspections of table I, subgroup 2 herein. Delta measurements shall be in accordance with table II herein.

* 4.4.2.1 Group B inspection, table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500.

Subgroup	Method	Conditions
B3	1037 or	For solder die attach: 2,000 cycles; V_{CB} = 10 - 30 V dc, $T_A \leq$ 35°C.
B3	1026	For eutectic die attach: V_{CB} = 10 - 30 V dc, $T_A \leq$ 35°C, adjust P_T to achieve T_J = 175°C minimum.
B5	3131	See 4.5.2.

* 4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-PRF-19500, and as follows. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta measurements shall be in accordance with table II herein.

Subgroup	Method	Conditions
C2	2036	Test condition A, weight = 10 pounds ±10 oz., t = 15 s.
C5	3131	See 4.5.2.
C6	1037 or	For solder die attach: 6,000 cycles; V_{CB} = 10 - 30 V dc, $T_A \leq$ 35°C.
C6	1026	For eutectic die attach: V_{CB} = 10 - 30 V dc, $T_A \leq$ 35°C, adjust P_T to achieve T_J = 175°C minimum.

* 4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table IX of MIL-PRF-19500 and as specified in table III herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

4.5 Method of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

* 4.5.2 Thermal resistance. Thermal resistance measurements shall be conducted in accordance with test method 3131 of MIL-STD-750. $R_{\theta JC}$ shall be in accordance with figure 3, thermal impedance curve. The following details shall apply.

a. Collector current magnitude during power applications shall be 2 A dc.

b. Collector to emitter voltage magnitude shall be 20 V dc.

c. Reference temperature measuring point shall be the case.

d. Reference point temperature shall be +25°C $\leq T_R \leq$ +75°C and recorded before the test is started.

* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical examination	2071					
Subgroup 2						
Thermal impedance	3131	See 4.3.2	$Z_{\theta JC}$			
Collector to emitter breakdown voltage	3011	Bias condition D; I_C = 3 A dc, pulsed (see 4.5.1), see figure 4	$V_{(BR)CEO}$	140		V dc
Collector to emitter breakdown voltage	3011	Bias condition B; I_C = 1.5 A dc, R_{BE} = 100 Ω, see figure 4	$V_{(BR)CER}$	150		V dc
Collector to emitter breakdown voltage	3011	Bias condition A; I_C = 1.5 A dc, V_{EB} = 1.5 V dc, see figure 4	$V_{(BR)CEX}$	160		V dc
Collector to emitter cutoff current	3041	Bias condition A; V_{CE} = 125 V dc, V_{EB} = 1.5 V dc	I_{CEX}		0.1	mA dc
Collector to base cutoff current	3036	Bias condition A; V_{CE} = 125 V dc, V_{EB} = 1.5 V dc	I_{CBO1}		0.1	mA dc
Emitter to base cutoff current	3061	Condition D; V_{CB} = 140 V dc	I_{EBO}		0.1	mA dc
Base emitter voltage (nonsaturated)	3066	Test condition B; pulsed (see 4.5.1), I_C = 3 A dc, V_{CE} = 4.0 V dc	V_{BE}		1.7	V dc
Saturation voltage and resistance	3071	Pulsed (see 4.5.1), I_C = 3 A dc, I_B = 300 mA dc	$V_{CE(sat)}$		1.0	V dc
Forward-current transfer ratio	3076	V_{CE} = 4 V dc, I_C = 3 A dc, pulsed (see 4.5.1)	h_{FE1}	20	70	mA

See footnote at end of table.

* TABLE I. Group A inspection – Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 3						
High temperature operation:		T_A = +150°C				
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 140 V dc	I_{CBO2}		1.0	mA dc
Low temperature operation		T_A = -55°C				
Forward current transfer ratio	3076	V_{CE} = 4 V dc, I_C = 3 A dc, pulsed (see 4.5.1)	h_{FE2}	15		
Subgroup 4						
Small-signal short-circuit forward-current transfer ratio	3306	V_{CE} = 4 V dc, I_C = 3 A dc, f = 100 kHz	h_{fe}	1.0		
Subgroup 5						
Safe operating area (continuous dc)	3051	T_C = +25°C; t = 1 s				
Test 1		V_{CE} = 11.7 V dc, I_C = 10 A dc				
Test 2		V_{CE} = 78 V dc, I_C = 1.5 A dc				
Test 3		V_{CE} = 125 V dc, I_C = 0.5 A dc, see figure 5				
Electrical measurements		See table I, subgroup 2 herein				
Subgroups 6 and 7						
Not applicable						

1/ For sampling plan, see MIL-PRF-19500.

* TABLE II. Groups B and C delta measurements. 1/ 2/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Collector to emitter cutoff current	3041	Bias condition A; V_{CE} = 125 V dc V_{EB} = 1.5 V dc	ΔI_{CEX} 3/	100 percent of initial reading or 500 μA dc, whichever is greater.		

1/ The delta measurements for table VIb (JAN, JANTX and JANTXV) of MIL-PRF-19500 are as follows:

a. Subgroup 3, see table II herein, step 1.

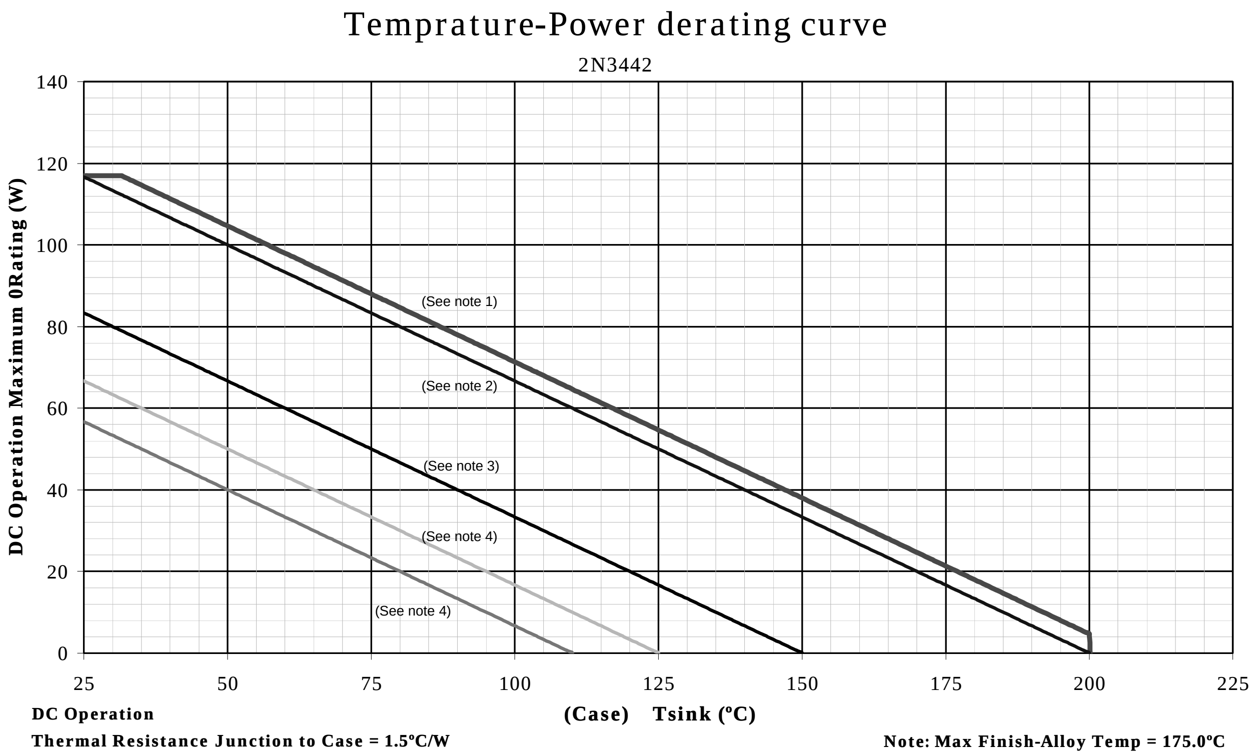
b. Subgroup 6, see table II herein, step 1.

2/ The delta measurements for table VII of MIL-PRF-19500 are as follows: Subgroup 6, see table II herein, step 1.

3/ Devices which exceed the group A limits for this test shall not be accepted.

* TABLE III. Group E inspection (all quality levels) - for qualification and re-qualification only.

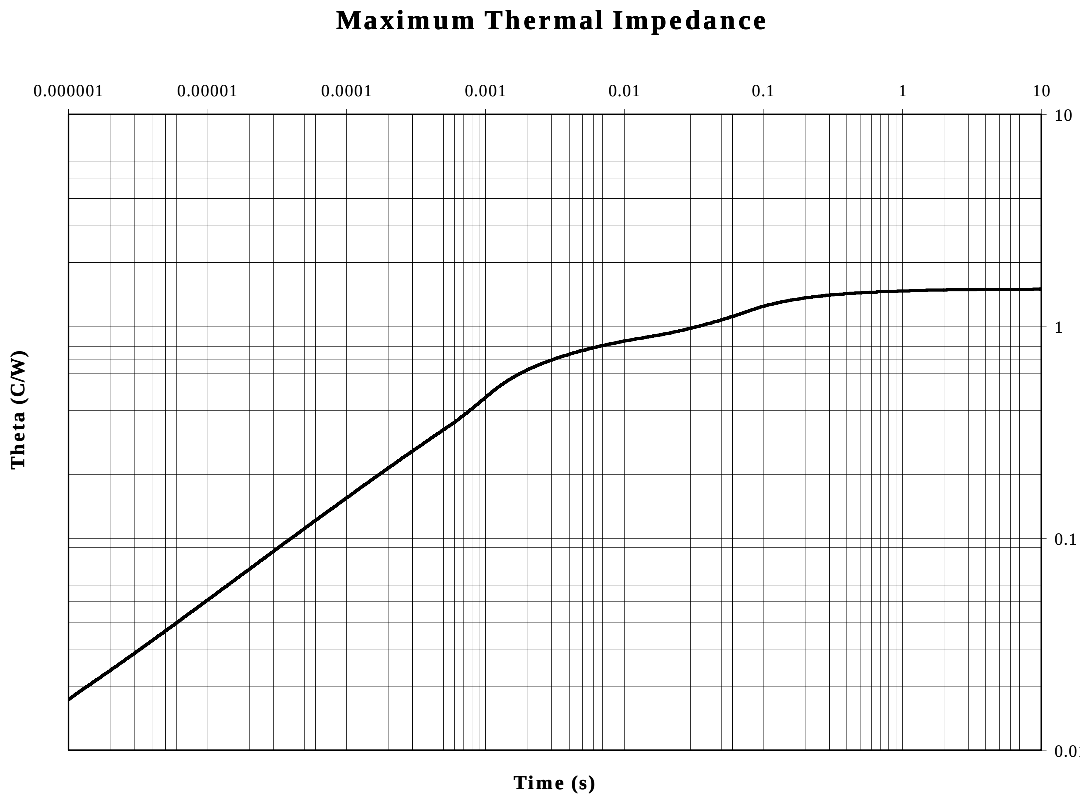
Inspection	MIL-STD-750		Qualification
	Method	Conditions	
Subgroup 1			45 devices c = 0
Temperature cycling	1051	Test condition G, 500 cycles	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table I, subgroup 2 herein.	
Subgroup 2			45 devices c = 0
Steady-state dc blocking life	1039 or 1049	Condition A; 1,000 hrs	
Electrical measurements		See table I, subgroup 2 herein.	
Subgroup 3			3 devices c = 0
DPA	2102		
Subgroup 4			sample size N/A
Thermal impedance curves		Each supplier shall submit their (typical) design thermal impedance curves. In addition, test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report	
Subgroups 5, 6, and 7			
Not applicable			
Subgroup 8			45 devices c = 0
Reverse stability	1033	Condition A for devices $\geq$ 400 V, condition B for devices < 400 V.	



NOTES:

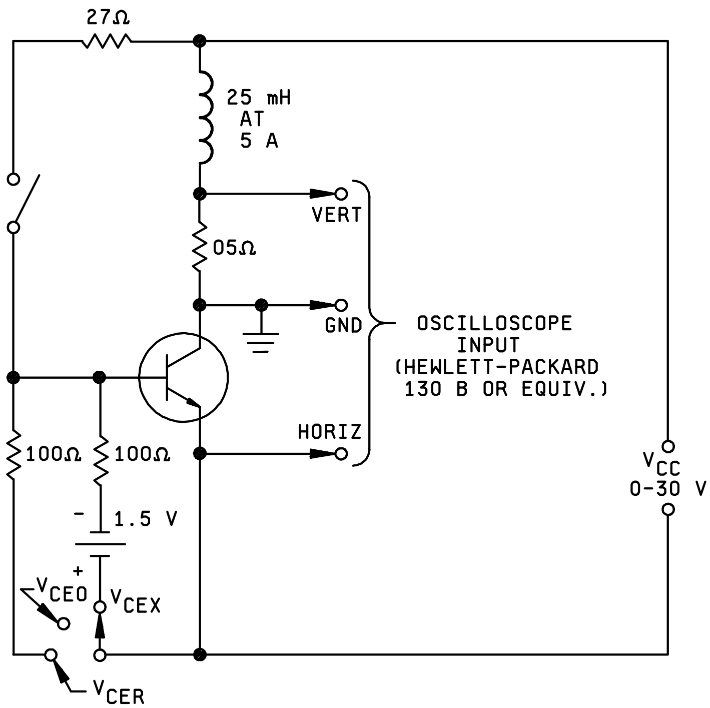
1. Maximum theoretical derate design curve. This is the true inverse of the worst case thermal resistance value. All devices are capable of operating at ≤ T_J specified on this curve. Any parallel line to this curve will intersect the appropriate power for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See paragraph 1.3)
3. Derate design curve chosen at $T_J \leq +150$°C, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq +125$°C, and +110°C to show power rating where most users want to limit T_J in their application.

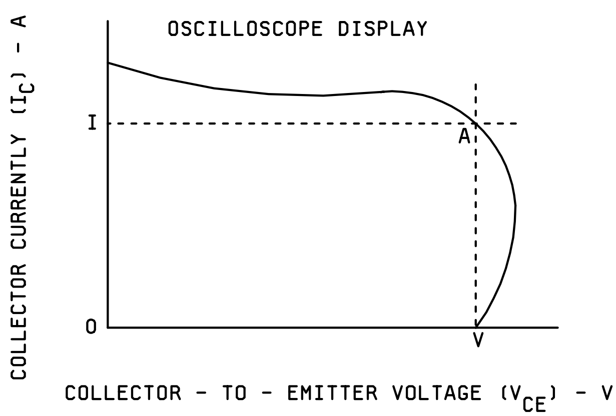
* FIGURE 2. Temperature derating graph (2N3442, TO-3).



T_C = +25C. Thermal resistance = 1.5°C/W.

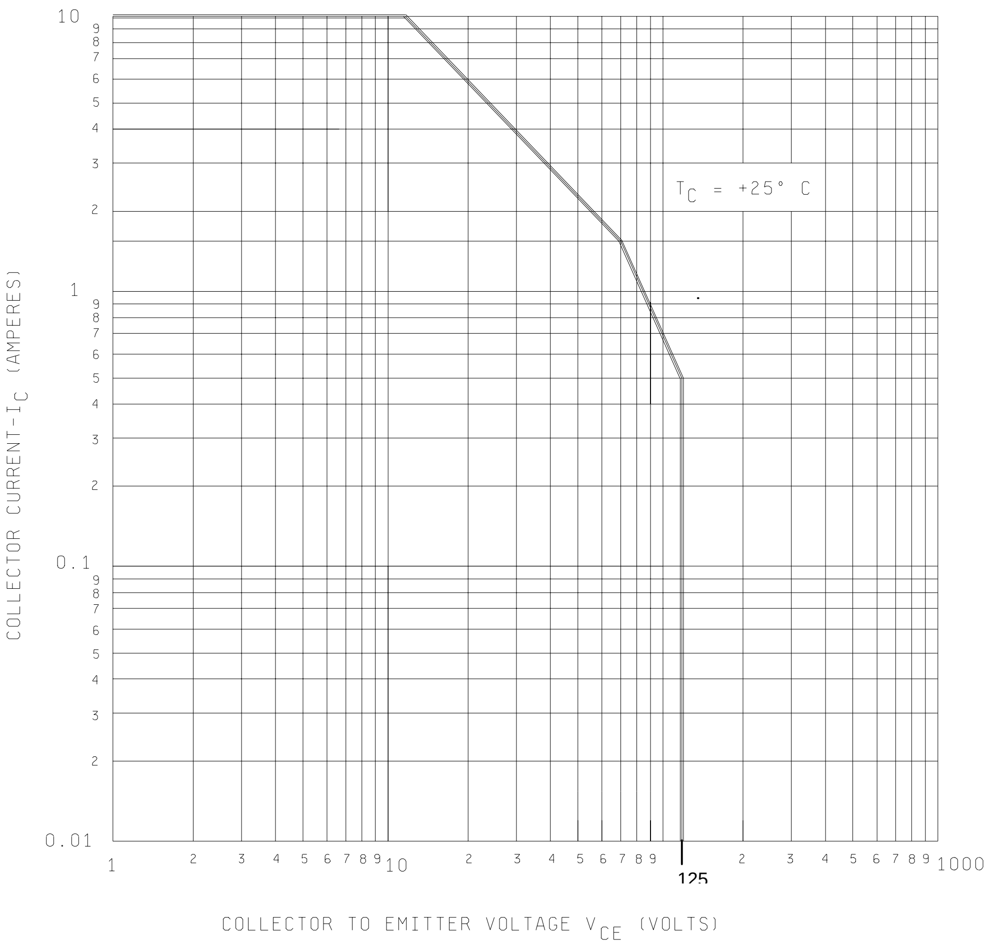
* FIGURE 3. Transient thermal impedance graph (2N3442, TO-3).





NOTE: The voltages V_{CEO}, V_{CER}, or V_{CEX} are acceptable when the trace falls to the right and above point "A".

* FIGURE 4. Test circuit for V_{CEO}, V_{CER}, and V_{CEX}.



* FIGURE 5. Maximum safe operating graph (dc).

5. PACKAGING

* 5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

* 6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.

b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2).

c. Packaging requirements (see 5.1).

d. Lead finish (see 3.4.1).

e. Type designation and product assurance level.

* 6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers' List (QML) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC/VQE, P.O. Box 3990, Columbus, OH 43216-5000.

* 6.4 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Army - CR
Navy - EC
Air Force - 11
DLA - CC

Review activities:
Army - AV, MI
Navy - AS, MC
Air Force - 19, 99

Preparing activity:
DLA - CC

(Project 5961-2805)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/370E	2. DOCUMENT DATE 5 November 2003

3. **DOCUMENT TITLE**
SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, HIGH POWER, TYPE 2N3442, JAN, JANTX, AND JANTXV

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) COMMERCIAL DSN FAX EMAIL	7. DATE SUBMITTED

8. PREPARING ACTIVITY

a. Point of Contact Alan Barone	b. TELEPHONE Commercial 614-692-0510 DSN 850-0510 FAX 614-692-6939 EMAIL alan.barone@dla.mil
c. ADDRESS Defense Supply Center Columbus ATTN: DSCC-VAC P.O. Box 3990 Columbus, OH 43216-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman, Suite 2533 Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888